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conclusions bear, an attempt is made here to state clearly and tersely LEPESCHKIN'S conception of the various processes concerned in the movements by motor organs.

A change in illumination induces a change in the permeability of the plasma membranes for solutes; this results in an alteration of the turgor pressure, which of course alters the volume of the opposed halves of the motor organ, and alters it in the same fashion, though not at the same rate or to the same extent. Darkening reduces permeability, and consequently increases the turgor; lighting has the opposite effect. The result of the inequalities of these changes in turgor is a curvature of the pulvinus. After this has appeared, diffusion of the solutes begins toward the convex side, where the concentration is now lowest in consequence of the absorption of water in this half and its expulsion on the concave side; this leads to the restoration of the normal concentration of sap and a resultant heightening of turgor on the convex side, with a corresponding lowering of it on the other, thus intensifying the curvature. Alteration of permeability by changes of illumination is not peculiar to motor organs, but occurs also in epidermal cells of Tradescantia and in Spirogyra, where it is proportionally as great, but cannot have the same consequences.[16] Of the two movements ordinarily induced by change in illumination, the rise or fall of the leaf and the reverse, only the primary movement is produced as described; the reverse movement is rather of the nature of an after-effect of the primary curvature. Geotropic curvatures of the motor organs are explicable on the same principles. The physiological dorsiventrality of the motor organs is due to the normal direction of gravity. Plants which raise their leaves on darkening, have their photeolic movements intensified by being inverted, while those that drop their leaves have them reversed by inversion.—C. R. B.

Seedling structure of gymnosperms.—The third paper under this title, by HILL and FRAINE,[17] treats of the Ginkgoales and Cycadales, and contains the usual valuable coordination of scattered results. Under the three heads of cotyledons, transition region, and root, the following conclusions are reached:

Cotyledons.—The cotyledons, generally two in number, are hypogeal and are persistently imbedded in the gametophyte; they are frequently unequal and there is a marked tendency to form lobes, and in some cases there is a short basal tube; among Cycadales they are more or less closely fused by their ventral surfaces; stomata are generally present, secretory cells and canals are common, and the vascular bundles are mesarch or exarch in varying degrees; the number of bundles in each cotyledon varies from one to eight, in all cases being greater in the central region than near the base or tip.

Transition region.—The transition phenomena occur rapidly, so that most of the hypocotyl shows root structure; Ginkgo differs from the observed cycads in that it has a rotation of the protoxylem of the cotyledonary traces; in Ginkgo each cotyledonary bundle gives rise to two poles of the root (except in the case of three cotyledons, when the root is triarch); among cycads the cotyledonary bundles are not of equal value in the production of root structure, and even similarly situated bundles vary in the same species; among the cycads the cotyledonary bundles fuse with the plumular traces and ultimately form a central cylinder of variable structure.

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[16] See also TRÖNDLE, p. 318.

[17] HILL, T. G., AND FRAINE, E. DE, On the seedling structure of gymnosperms. III. Annals of Botany **23**:433–458. *pl. 30.* 1909.

Root.—In Ginkgo there may be an addition of protoxylem elements after the root structure has been organized; in Stangeria the primary root may branch dichotomously; after the initial root structure has been attained, the number of poles may be increased at lower levels.

The paper closes with a very useful table showing the variation in the number of bundles in the base of the cotyledons of the fourteen species discussed, and also the relation of this number to the number of poles in the root structure.—J. M. C.

Adaptation in fossil plants.—In his presidential address[18] at the anniversary meeting (May 24) of the Linnean Society, SCOTT took occasion to outline the evidence for adaptation from fossil plants, which naturally dealt chiefly with the anatomical structures of those ancient vascular plants which he has done so much to elucidate. No one is more competent to state the facts in reference to ancient plants, but the conclusions do not seem to be irresistible. In substance they are as follows: (1) at all known stages in the history of plants there has been a thoroughly efficient degree of adaptation to the conditions existing at each period; (2) the characters of plants always having been as highly adaptive as they are now, natural selection appears to afford the only key to evolution which we possess at present; (3) the paleontological record reveals only a relatively short section of the whole evolution of plants, during which there has not been any very marked advance in organization, except in cases where the conditions have become more complex, as illustrated by the floral adaptations of angiosperms; (4) the simple forms of the present flora are reduced rather than primitive, but such reduction may have set in often at a relatively early stage of evolution, and is therefore consistent with a considerable degree of antiquity in the reduced forms.

These broad statements, quite apart from their application to certain views of adaptation, contain much wholesome truth for those who imagine that the paleontological record, as we know it, represents a continuous succession of "higher and higher" plants, for it is becoming increasingly evident that very highly organized plants existed at the very beginning of our record.—J. M. C.

Morphology of Penaeaceae.—STEPHENS published a preliminary account[19] of his studies among the Penaeaceae which was noticed in this journal.[20] There has now appeared the full account with illustrations,[21] so that the morphological

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[18] SCOTT, D. H., Presidential address before Linn. Soc., 1909. pp. 15.

[19] STEPHENS, E. L., A preliminary note on the embryo sac of certain Penaeaceae. Annals of Botany **22**:329. 1908.

[20] BOT. GAZETTE **45**:365. 1908.

[21] STEPHENS, E. L., The embryo sac and embryo of certain Penaeaceae. Annals of Botany **23**:363–378. *pls. 25, 26.* 1909.